

Driving Insomnia: A Driving Simulator Study

Angeliki Konsta¹, Eva Michelaraki², Dimosthenis Pavlou², Anastasios Bonakis^{1,3}, George Yannis², Dimitris Dikeos¹



¹First Department of Psychiatry, Athens University Medical School, National and Kapodistrian University of Athens, Greece
²Department of Transportation Planning and Engineering, School of Civil Engineering, National Technical University of Athens
³Second Department of Neurology, Athens University Medical School, National and Kapodistrian University of Athens, Greece

1. Introduction

Sleep-related problems are known risk factors for road crashes. However, few studies have investigated the role played by insomnia and its daytime symptoms including fatigue and sleepiness [1-2].

Driving, as a part of everyday life, is a **complex activity that requires mental and functional abilities** [3] such as attention (which helps to quickly perceive the environment and avoid accidents), visual and spatial skills (position of the car on the road, maneuvers of the car in lanes of change, calculation of distance and speed), executive functions (processing of multiple-often simultaneous-environmental stimuli, forecasting of road situations and direct decision-making with accuracy and safety) and memory (route planning, behavior adjustment, recognition and memorization of highway code signals).

2. Objectives

The aim of this study is to **understand the effects of insomnia on driving performance**.

3. Methods

3.1 Questionnaire

Good sleeper controls and patients with chronic insomnia as defined by the International Classification of Sleep Disorders (ICSD) completed a sleep diary and filled in a questionnaire. Participants have also provided valuable information with regards to demographic characteristics, such as age, gender, educational level, etc.

3.2 Driving simulator experiment

For the purpose of this research, **30 drivers (17 males and 13 females)** aged 23-70 participated in a driving simulator experiment.

All drivers went through the same experimental procedure. The driving

simulator experiment started with a practice drive (15 minutes), until they fully familiarized with the simulation environment. Then, participants were invited to drive on **a rural and urban road under different traffic conditions** (i.e. high/low traffic volume) and four driving scenarios were developed.

The **driving performance measures** that were extracted and analyzed are shown in Table 1.

Table 1. Description of the driving performance measures used in the analysis

Independent Variables	Description
Mean speed	Mean speed of the driver's vehicle along the route, excluding the small sections in which incidents occurred, and excluding junction areas
Headway	Time distance between the front of the simulator vehicle and the front of the vehicle ahead
Reaction time at unexpected incidents	Time between the first appearance of the incident on the road and the moment the driver starts to brake in milliseconds
Lateral position	Vehicle's distance from the central road axis in metres
Lateral position variability	The standard deviation of lateral position
Wheel steering angle	The mean wheel steering angle in degrees
Steering angle variability	The standard deviation of steering angle

4. Results

Preliminary results from 12 insomniacs and 18 controls indicated that **drivers with insomnia had higher accident incidents than those without insomnia**. Insomniacs maintained a longer distance from the preceding vehicle, while their average driving speed and was lower compared to individuals without insomnia.

Furthermore, a larger standard deviation of lateral position and an **increased number of right edge-line crossings** in insomnia patients was noted compared to good sleepers.

One fundamental question regarding the impact of insomnia on driving performance was to what extent participants believe that their **sleep disorders interfere with their daily routine** (e.g. fatigue, emotions, concentration, memory, attention, driving tasks, ability to work, home responsibilities, etc.). Interestingly, the vast majority 92% (11 up to 12) of

patients with chronic insomnia indicated that they face serious difficulties in coping with the driving task, while they had significantly **worse reaction time and driving performance** compared to good sleeper controls.

It is worth mentioning that both control and case male drivers had **increased driving errors**, exhibited more aggressive behavior, drove at higher speeds and maintained shorter headway distance from the vehicle in front than the more conservative female drivers in all traffic conditions. This finding is in agreement with the international literature which have proven that the majority of women drive more carefully and ecologically than men [4].

5. Conclusions

The present research endeavored to identify the impact of insomnia on road safety. To fulfill this goal, a driving simulator experiment was conducted and a questionnaire was filled in a sample of 30 drivers. Results demonstrated that patients with chronic insomnia show a **lesser ability to maintain a steady lateral position of their vehicle**, while they seem to drive more conservatively by keeping a lower speed and a higher safety distance from the preceding vehicle. Future research efforts could consider additional risk factors (e.g. anger, sleepiness or fatigue) and extend the experiment to real driving conditions.

References

- [1] Johansson, K., Wasling, P., & Axelsson, M. (2021). Fatigue, insomnia and daytime sleepiness in multiple sclerosis versus narcolepsy. *Acta Neurologica Scandinavica*, 144(5), 566-575.
- [2] Garbarino, S., Magnavita, N., Guglielmi, O., Maestri, M., Dini, G., Bersi, F. M., ... & Durando, P. (2017). Insomnia is associated with road accidents. Further evidence from a study on truck drivers. *PLoS one*, 12(10).
- [3] Beratis, I. N., Pavlou, D., Papadimitriou, E., Andronas, N., Kontaxopoulou, D., Fragkiadaki, S., ... & Papageorgiou, S. G. (2017). Mild cognitive impairment and driving: does in-vehicle distraction affect driving performance?. *Accident Analysis & Prevention*, 103, 148-155.
- [4] Braly, A. M., Parent, M. C., & DeLucia, P. R. (2018). Do threats to masculinity result in more aggressive driving behavior?. *Psychology of Men & Masculinity*, 19(4), 540.